# USDA-ARS Coordinated Project on Minimizing the Exposure of Honey Bees to Pesticides

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## I. Pesticide exposure affects the overwintering ability of honey bees

**Introduction**

Reduced overwintering ability of honey bees has been suspected to be caused by an increased exposure to pesticides. During the warm season, the colony consists of "summer bees" which typically live for only several weeks as adults. "Winter bees" develop in late summer or autumn when brood rearing deceases. Winter bees must live for at least several months to ensure winter survival of the colony. There are physiological differences between summer and winter bees, and winter bee physiology may be compromised by exposure to pesticides.

**Objective**

**• Correlate honey bee exposure to pesticides with physiology of winter bees and survival of colonies**

**Hypothesis**

**• Repeated exposure to pesticides results in honey bees lacking winter bee physiology, and this reduces winter survival**

**Proposed Methods**

In April 2014, 120 colonies will be separated into two apiary types: 1) control yards that are expected to have low pesticide exposure because they are in an organically managed "Seed Saver" area, and 2) apiaries expected to be have greater pesticide exposure because they are in an area of normal agriculture (**Figure 1**). The colonies will be monitored and sampled throughout the year (**Figure 2**).

Colonies will be sampled at each time for (1) bee and brood populations, (2) brood quality, (3) Varroa mite infestations, (4) pesticide residues in hive bees, foragers, incoming pollen and surrounding foliage, (5) levels of detoxification enzymes, (6) concentrations of total protein and vitellogenin protein, (7) hypopharyngeal gland weight and (8) winter cluster temperature.

## Overall project objective:

**• Determine the potential impact of currently used pesticides and application practices on honey bee health**

**• Three sub-projects are highlighted here**

## II. Acute toxicity, synergistic/ antagonistic interactions of commonly used pesticides on honey bees

**Introduction**

It is unknown whether pesticide interacts or synergize with another chemicals affecting their toxicity against honey bees. This research is designed to optimize the chemical combination and to achieve effectively control of crop pests while minimizing chemical toxicity to honey bees. The data will be used for the development of guidelines in chemical selection for tank mixes and rotations.

**Proposed Objectives**

•Evaluate acute toxicity of commonly used pesticides
•Validate the pesticide toxicity via tarsal contact
•Assess synergistic/ antagonistic interaction of different pesticides
•Assessment of sub lethal impact of commonly used pesticides on honey be physiology

## III. Use of esterase activity as a biomarker for exposure to pesticides

**Introduction**

The activity of certain detoxification enzymes (esterases) may serve as simple, inexpensive biomarkers for exposure to different pesticides. We will test this possibility for honey bees in the laboratory, in the field and among different stocks.

**Objectives**

**• Create a biomarker "fingerprint" for different enzymes and bee stocks when bees are exposed to commonly used pesticides**

**• Correlate esterase enzyme activity with pesticide exposure in laboratory and field settings**

**Hypotheses**

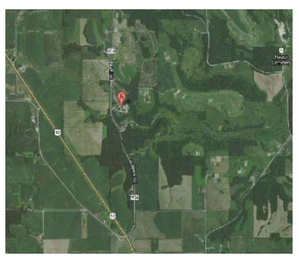
**• Laboratory and field exposure to pesticides will activate some (but not all) esterases to detoxify the pesticides**

**• Laboratory and field results will be correlated**

**Proposed Methods**

$LD_{10,25}$,and $_{50}$ of commonly used pesticides will be determined on forager bees of different stocks. Esterase activity towards alpha and beta naphthyl acetates will be compared using SDS-PAGE or spectrophotometry. Following the laboratory comparison of esterase activity, bees from other projects can be tested for esterase activity as a sign of pesticide exposure.

**Normal-exposure apiaries**

**Low-exposure ("Seed Saver") apiaries**

**Figure 1**

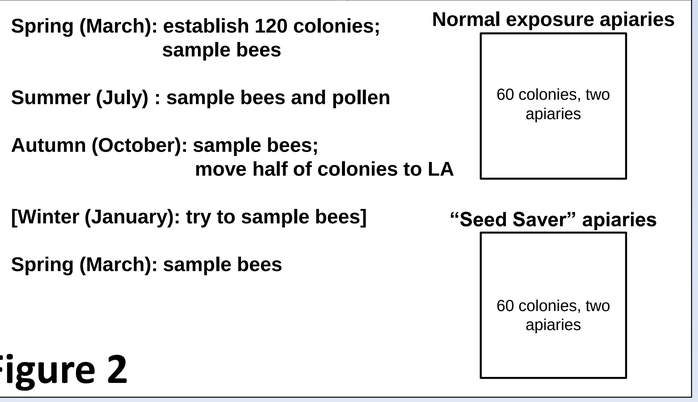



**Figure 2**

## Other sub-projects

**Profiling Neonicotinoid Residues from Seed Treatments and Foliar Applications when Applied to Corn, Cotton, and Soybean Grown in the Southern United States.** Mississippi State University

**Evaluate Honey Bee Exposure to Neonicotinoid Insecticides and Associated Colony Health in Agricultural and non-Agricultural Areas**. USDA-ARS Tucson, AZ, and University of Tennessee

**Developing Application Technologies to Reduce Exposure of Honey Bees to Pesticides** . USDA-ARS Aerial Application Technology, College Station, TX